Embedded Software Engineering

(Team-JBD)

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As firstly with an emphasis discussion we have chosen the automotive domain to define all the characteristics of embedded systems such as real time system, distributed system etc.

Automotive Domain:

Here an embedded system designed for a function or a specific software on the basis of particular components as physical environment such as many hardware components used in vehicle.

1. Sensors (Radar, Lidar, Camera etc.)
2. Actuators (electric actuators, hydraulic actuators)

On the basis of all the these we use “electronic control unit” (ECU’s) which is the part of Embedded System there are multiple ECU’s been designated in the vehicle on the basis of their functionality.

Electronic Control Unit inside Vehicle:

There is multiple ECU’s use in different application of Vehicle as in powertrain it has Engine control as we see in day-to-day life it also has hybrid control. Also with chassis we have steering ,braking ,suspension, Anti-lock braking system similarly we have different passive and active safety features in car with different ecu units whereas in ADAS which is called as Advanced Driving Assistance System has different level of car been modified on the basis of automatic driving such as from level 0 to level 6 so if level 0 is there means there is no automatic mode and level 6 which being full automatic without any human interaction so designing such car we have various ECU’s inside car.
From one domain to another, the electronic systems often have very different features. For example, the power train and chassis domains both exhibit hard real-time constraints and a need for high computation power. However, the

hardware architecture in the chassis domain is more widely distributed in the vehicle. The telematic domain presents requirements for high data throughput. From this standpoint, the technological solutions used are very different, for example, for the communication networks, but also for the design techniques and verification of the embedded software

As all the functions embedded in cars do not have the same performance or safety needs, different qualities of service are expected from the different subsystems. Typically, an in-car embedded system is divided into several functional domains that correspond to different features and constraints. Two of them are concerned specifically with real-time control and safety in the vehicle's behavior: the "power train" and the "chassis" domains. For these safety-critical domains, the technical solutions must ensure that the system is dependable (i.e., able to deliver a service that can be justifiably trusted) while being cost-effective at the same time.

Real time systems:
Multifunctional Camera : It is an Electronic control unit which has a sensor (camera with lens on it) with microcontroller unit with either 32 bit and 64 bit flash memory also it include cable connection to connect with higher level of bus networks (such as CAN /LAN/Flex ray).The multipurpose camera for assisted and partially automated driving utilizes an innovative, high-performance system-on-chip (SoC).The Real time system is generated in order to ensure that it fits a given ECU and system configuration. This means that a Real time environment implementation always provides the functionality that is needed for a given configuration, and nothing more on the industrial level The "MFC" manufactured with different generation by improving functionality each and every time and also.

Reactive system:

Embedded Communications The increasing complexity of electronic architectures embedded in a vehicle, and locality constraints for sensors and actuators, has led the automotive industry to adopt a **distributed approach** for implementing the set of functions. In this context, networks and protocols are of primary importance. They are the key support for integrating functions, reducing the cost and complexity of wiring, and furnishing a means for fault tolerance. Their impact in terms of performance and dependability is crucial as

a large amount of data is made available to the embedded functions through the networks.

Real time system

Power Train: The power train and chassis domains both exhibit hard real-time systems and a need for high computation power. The Power train domain represents the system that controls the engine according to requests from the driver (for example: speeding up, slowing down as transmitted by the position sensor or the brake pedal, etc.) and requirements from other parts of the embedded system such as climate control. In powertrain we can easily find continuous, discrete and it also act as Hard-core real time for implementation of performance evaluation and time analysis needs to be focussed majorly.

Distributed system:

Chassis Domain: It is a system which basically aims to control the interaction of car with road such as suspension wheel etc. whereas controllers consider the requests emitted by driver for steering, braking. This domain includes ABS (Anti-lock braking system), automatic control stability the chassis components are fully distributed onto a networked microcontroller, and they communicate with other systems the best characteristics suits for this domain is also real time operating systems**.**

Dependable system:

Human- Machine Interference: It is an interaction between driver and the numerous embedded function which is in the vehicle. The major functionalities are about the status of car, vehicle speed

One way to control the multimedia systems is to avoid too many buttons. The commands should be grouped in a way that minimizes the movements of the driver. The information needs to be clear and should not distract the driver's attention from the road.

Security: It can be computer security which aware about cyber risks related to all autonomous driving protect from harmful attacks.

Dependability: The main features which include the dependability of powertrain, control system, seats

Safety : Active Safety which as the action like brake assist, pedestrian detection lane departure warning and passive safety which as the action can be taken after crash as Airbags will blow up